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CAMBRIDGE UNIV (ENGLAND) DEPT OF ZOOLOGY J E TREHERNE
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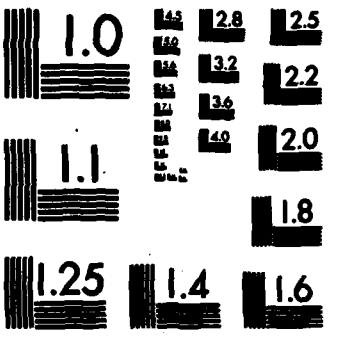

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CELLULAR MECHANISMS OF CENTRAL NERVOUS MODULATION

(1)

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Scientific activities

One of the primary aims of the investigation is to elucidate the effects of pharmacologically active compounds on the superficial neuroglia which constitute the insect blood-brain barrier. This requires a quantitative understanding of the permeability properties of the system. To evaluate some parameters of the insect blood-brain barrier, the potential recorded in the superficial neuroglial cells (the perineurium), and the potential recorded across these cells ~~(Fig. 1a),~~ have been interpreted in terms of an electrical model (Fig. 1b). In the model, the adglial membrane of the perineurial cells is represented by a potential (Ea), generated by ion concentrations across the membrane, and the membrane resistance (Ra). The basolateral membrane is similarly represented by a battery (Eb) and resistance (Rb), and the shunt by Es and Rs.

When the difference between Ea and Eb is not equal to Es then a current (I) flows along a path through one membrane, then the other, and back through the shunt. This causes a potential to appear across each resistance. The voltage recorded across each membrane, or across the shunt, is thus composed of a potential due to an ion battery and that due to current flow.

The voltage across the adglial membrane (Va) was measured as the difference between the voltage recorded in the cell, which is the basolateral membrane voltage (Vb), and the voltage recorded across the perineurium, which is the voltage across the shunt (Vs). Current was pulsed across the perineurium, using a third electrode, so that the trans-perineurial resistance (Rt) could be calculated from the resulting deflections in Vs, and the ratio Rb:Ra from the ratio between the deflections of Vb and Va.

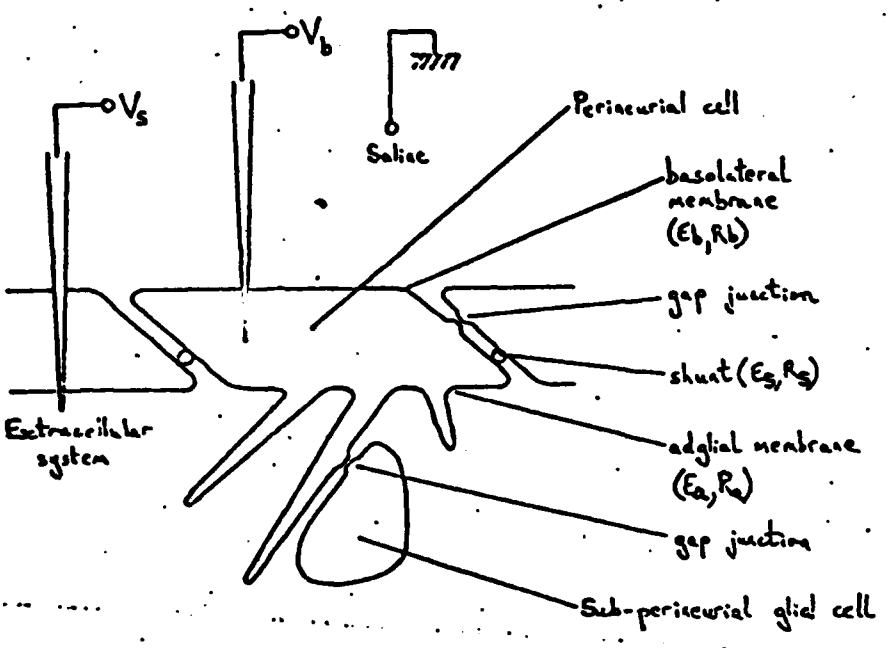
In the normal saline, Vs was positive, implying that Va was greater than Vb. This was assumed to arise principally from Ea being greater than Eb, rather than from a battery in the shunt. Rt had a value similar to that of tight epithelia. The ratio Rb:Ra indicated that the adglial membrane area was greater than that of the basolateral membrane, as is also indicated in electronmicrographs.

By raising the potassium concentration in the saline, changes in voltage and resistance were observed that could be interpreted in terms of potassium action upon the basolateral membrane to depolarize Eb and to decrease Rb. From the difference between the change in Vs and the change in Vs, the ratio Rs:Ra was calculated; and comparison with Rb:Ra showed that Rs was similar to Rb. There was a decrease in Rt and in Rb:Ra, as to be expected from a decrease in Rb.

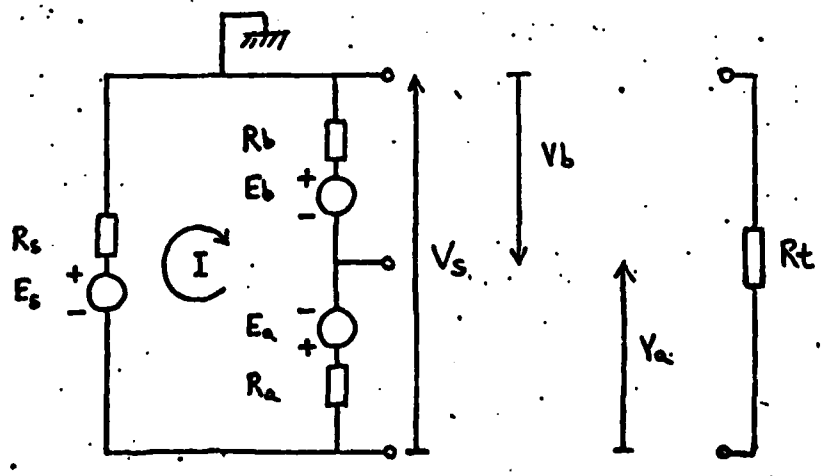
Comparable measurements from preparations that had been briefly exposed to hypertonic urea - a standard technique for making epithelia leaky - indicated that the treatment rendered the barrier leaky by damage to the shunt (rather than by damage to the cells) as earlier supposed.

Fig. 1

a) Schematic representation of perineurium and electrodes recording V_s and V_b.



b) Electrical model of perineurium.



Publication

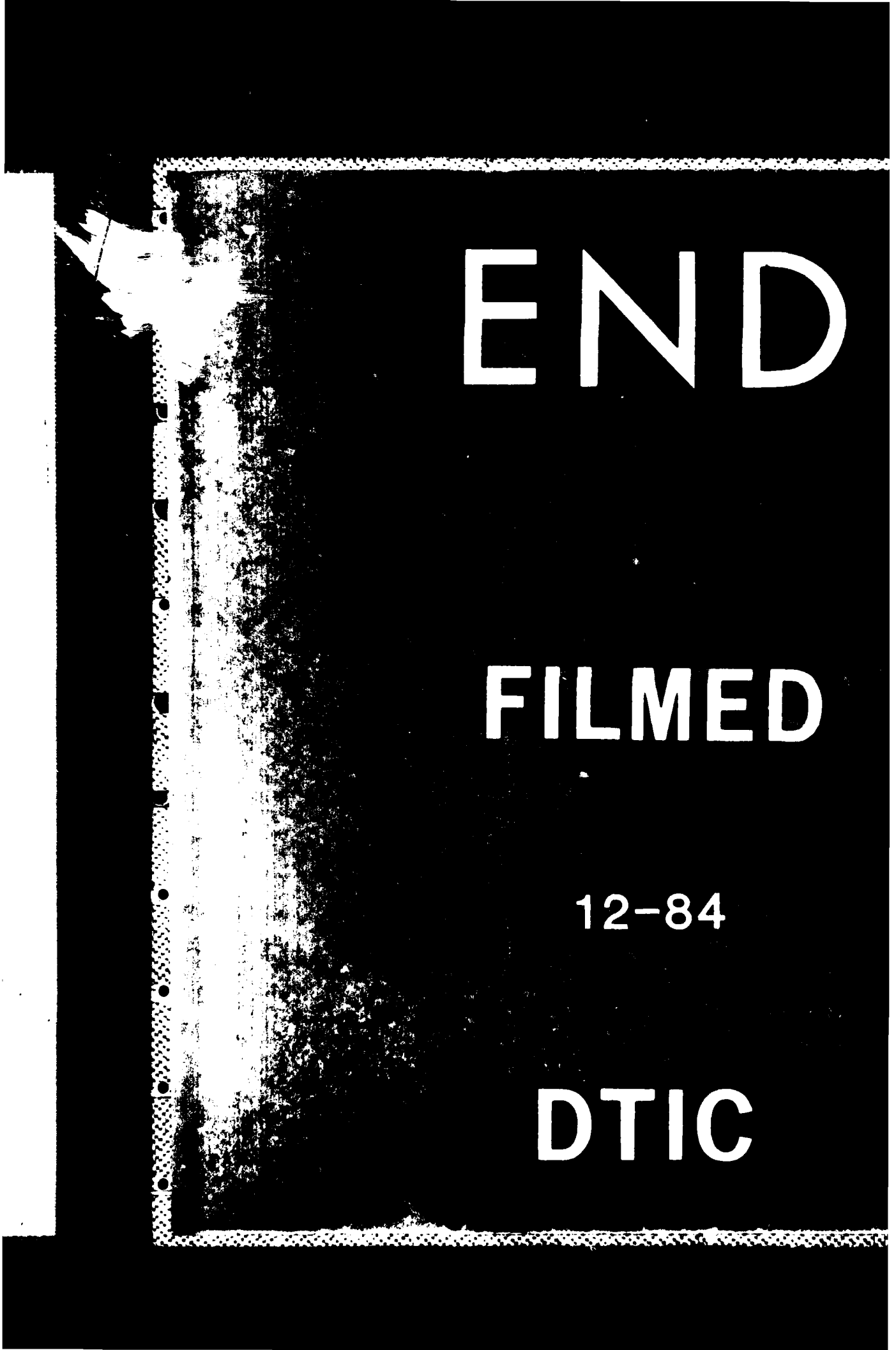
Treherne, J.E., Schofield, P.K. & Lane, N.J. (1982). Physiological and ultrastructural evidence for an extracellular anion matrix in the central nervous system of an insect (Periplaneta americana). Brain Res. 247, 255-267.

Future Research Plans

It is proposed to use the above model to elucidate the effects of octopamine and other pharmacologically active compounds on the properties of the perineurial glia. Research will also be continued on the processes involved on the control of glial activation, both in vitro and in vivo. In particular it is proposed to investigate the role of haemocytes in glial activation during nerve regeneration.

Significant administrative actions

Dr. Peter Smith replaces Dr. Colin Leech in his research assistantship.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